COMMUNICATION SYSTEM HAVING A FLEXIBLE TRANSMIT CONFIGURATION

Background of the Invention

1. Field of the Invention

The present invention relates to communications; more specifically, wireless communications.

2. Description of the Related Art

Prior communication systems have been designed around one type of transmit configuration. In older systems, a single antenna is used for transmitting. In newer systems, one of several other types of transmit configurations have been used but they did not provide flexibility to address channel conditions such as the degree of mobility associated with a mobile station.

Summary of the Invention

The present invention provides a communication system with a transmit configuration that may be reconfigured based on mobile station associated conditions such as the capability of the mobile receiver, carrier to interference or signal to noise ratios, and the degree of mobility associated with the mobile station. As a result, the transmit configuration is optimized for the conditions associated with a particular mobile receiver. In one embodiment, the transmit configuration may be selected to operate in configurations such as a single transmit antenna configuration, a space time spreading configuration, a selective transmit diversity configuration, and a multi-output and multi-input configuration.

Brief Description of the Drawings

FIG. 1 illustrates a single transmit antenna configuration;

FIG. 2 illustrates a selective transmit diversity configuration;

FIG. 3 illustrates a space time spreading configuration; and

FIG. 4 illustrates a multi-output and multi-input configuration.

Detailed Description

When a mobile station initially makes contact with a base station requesting a communication channel, it transmits information such as its electronic serial number (ESN), and mobile associated channel conditions such as carrier to interference ratio ($\frac{C}{I}$), signal to noise ratio ($\frac{S}{N}$), the mobile station's degree of mobility (whether the mobile is standing still, moving slowly or moving at a relatively high speed) and the transmit configurations supported by the mobile. Additionally, the base station transmits its capabilities to mobile stations on a channel such as a paging channel or synchronization channel where is indicates the types of transmit configurations that are available. In one embodiment, based on the information provided by the mobile station and the capabilities of the base station, the base station provides one of four different transmit configurations for communications with the mobile station. The selected transmit configuration is communicated to the mobile station using a control channel such as a paging channel or synchronization channel.

In one embodiment, the four transmit configurations are a single transmit antenna configuration, a selective transmit diversity configuration, a space time spreading configuration and a multi-input/multi-output configuration. The use of these four configurations is provided for instructional purposes. Different numbers and different types of configurations may be used.

FIG. 1 illustrates a single transmit antenna configuration. Base station 10 communicates with mobile 20 using a single antenna at both the base station and mobile station. This configuration may be the default configuration and is typically assigned when the mobile has a high degree of mobility. High degrees of mobility correspond to times such as when the mobile station is in a motor vehicle or a train.

FIG. 2 illustrates a selective transmit configuration. In this configuration, base station 30 communicates with mobile station 40 using one of multiple transmit antennas and one antenna at the mobile station. Communications are tested using each of antennas 44 and 46, and then the mobile reports to the base station which of the two antennas provided superior communications. Superior communications may be determined using factors such as carrier to interference ratios, signal to noise ratios or error rates. This configuration is typically used when there are poor channel conditions such as low carrier to interference ratio and the mobile has a low level of

mobility. Low mobility corresponds to situations such as the mobile being stationary or being carried by a user as he or she walks.

FIG. 3 illustrates a space time spreading configuration. Base station 50 communicates with mobile station 60 using at least two transmit antennas at the base station simultaneously and one receive antenna at the mobile station. In this configuration each of the transmit antennas uses a different Walsh code for the data that is transmitted through the antenna. In the case of two antennas as illustrated in the figure, antennas 62 and 64 carry data encoded with different orthogonal codes such as Walsh codes. This type of configuration is typically used in situations where channel conditions are good; that is, the carrier to interference ratio or signal to noise ratio is high and the mobility of the mobile station is low.

FIG. 4 illustrates a multi-input/multi-output transmit configuration. In this configuration base station 70 transmits to mobile station 80 using at least two transmit antennas and mobile station 80 receives the signals using at least two receive antennas. In this configuration data is simultaneously transmitted on antennas 82 and 84, and it is received by antennas 86 and 88. This type of configuration is typically used where there are good channel conditions such as a high carrier to interference ratio or signal to noise ratio, where the mobility of the mobile station is low, and where the mobile station has multiple receive antennas.

Other types of known configurations may be used or a subset of the above described configurations may be used based on the capabilities of the base station and mobile station associated channel conditions such as the capabilities of the mobile station, carrier to interference ratio, the signal to noise ratio and the mobile station's mobility.